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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/912,103	07/23/2001	Huong Thanh Nguyen	5619/DD/LOW K/JW	4476
32588	7590	08/08/2006	EXAMINER	
APPLIED MATERIALS, INC. 2881 SCOTT BLVD. M/S 2061 SANTA CLARA, CA 95050			NGUYEN, KHIEM D	
			ART UNIT	PAPER NUMBER
			2823	

DATE MAILED: 08/08/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/912,103	Applicant(s) NGUYEN ET AL.	
	Examiner Khiem D. Nguyen	Art Unit 2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 19 May 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-24 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-24 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 23 July 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION***Response to Applicants' Amendment***

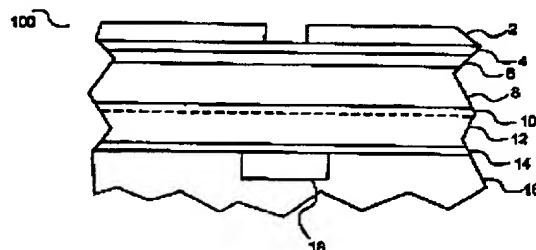
1. The non-final rejection as set forth in paper No. (021606) mailed on February 22nd, 2006 is withdrawn in response to applicants' amendments. A new rejection is made as set forth in this Office Action. Claims (1-24) are pending in the application.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.
3. Claims 1-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Flanner et al. (U.S. Patent 6,410,437) in view of Gabriel et al. (U.S. Patent 6,599,839).

In re claim 1, **Flanner** discloses a method of fabricating a damascene structure, comprising: (a) forming a barrier layer 14 on a substrate 16 having a metal layer 18 thereon; (b) forming a first organosilicate layer 12 on the barrier layer 14; (c) forming a silicon oxide layer 10 on the first organosilicate layer 12; (d) forming a second organosilicate layer 8 on the silicon oxide layer 10 (col. 4, line 47 to col. 5, line 50 and FIG. 3); and

**FIG. 3**

(e) etching the second organosilicate layer 8 to define vias 20 therein, wherein the second organosilicate layer 8 is etched with a gas mixture comprising a $\text{Ar/N}_2/\text{CF}_4$, $\text{Ar/N}_2/\text{F}_6$, and $\text{Ar/N}_2/\text{C}_9\text{F}_8/\text{O}_2$ (col. 5, lines 50-64 and FIG. 6).

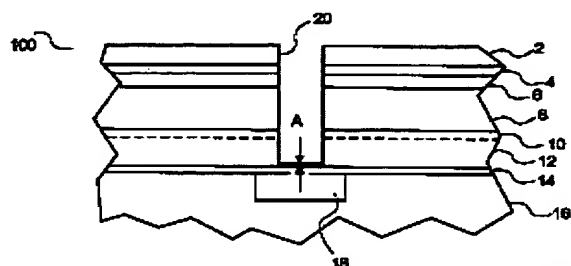


FIG. 6

Flanner discloses etching the second organosilicate layer 8 to define vias 20 therein, wherein the second organosilicate layer 8 is etched with a gas mixture comprising a $\text{Ar/N}_2/\text{CF}_4$, $\text{Ar/N}_2/\text{F}_6$, and $\text{Ar/N}_2/\text{C}_9\text{F}_8/\text{O}_2$ (col. 5, lines 50-64 and FIG. 6) but does not explicitly teach that the second organosilicate layer is etched with a gas mixture comprising a hydrogen containing fluorocarbon and one or more gasses selected from the group consisting of hydrogen (H_2), nitrogen (N_2), oxygen (O_2), argon (Ar), and Helium (He) as recited in the independent claim 1.

Annapragada, however, discloses a method of fabricating a damascene structure, comprising: (a) forming a barrier layer 412 on a substrate 410 having a metal layer 404 thereon; (b) forming a first organosilicate layer 416 on the barrier layer 412;

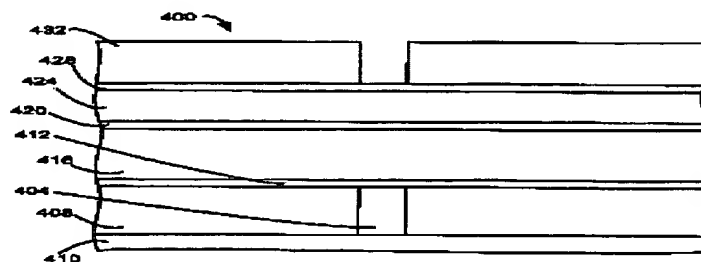


FIG. 4A

(c) forming a trench etch stop layer **420** on the first organosilicate layer **416**; (d) forming a second organosilicate layer **424** on the trench etch stop layer **420** (col. 2, line 46 to col. 3, line 21 and FIGS. 4A-B); and

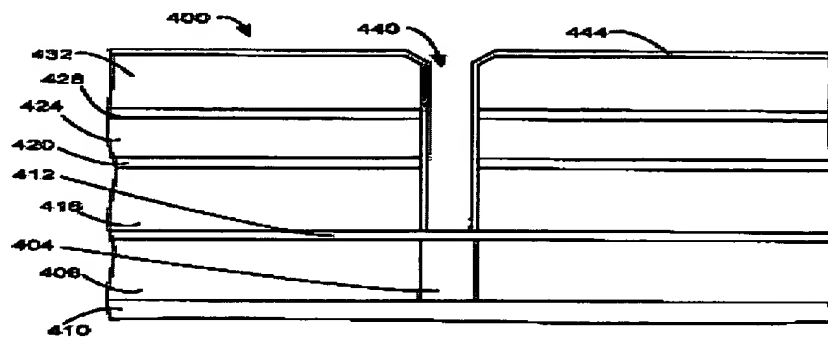


FIG. 4B

(e) etching the second organosilicate layer **424** to define vias **440** therein, wherein the second organosilicate layer **424** is etched with a gas mixture comprising a hydrogen-containing fluorocarbon and one or more gases selected from the group consisting of hydrogen (H₂), nitrogen (N₂), oxygen (O₂), argon (Ar), and helium (He) (col. 4, lines 9-67).

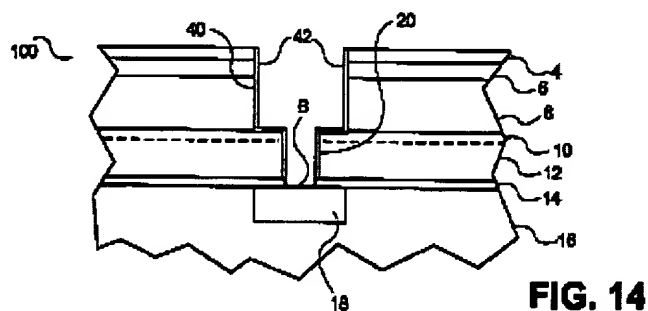
Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine the teaching of Flanner and Annapragada to enable the process of etching the second organosilicate layer using a gas mixture comprising a hydrogen-containing fluorocarbon and one or more gases selected from the group consisting of hydrogen (H₂), nitrogen (N₂), oxygen (O₂), argon (Ar), and helium (He) of Flanner to be performed and furthermore to provide an efficient etching process with minimal structure damage (col. 1, lines 61-62. Annapragada).

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In re claim 2, as applied to claim 1 above, Flanner in combination with Annapragada disclose all claimed limitations including the limitation wherein the method, further comprising:

(f) etching the silicon oxide layer 10 to transfer the vias 20 defined in the second organosilicate layer 8 therethrough (FIG. 6, Flanner);

(g) patterning the second organosilicate layer 8 to define interconnects 40 therethrough, wherein the interconnects 40 are positioned over the vias 20, and wherein the via pattern is transferred through the first organosilicate layer 12 when the interconnects 40 are defined in the second organosilicate layer 8 (FIG. 14, Flanner); and



(g) filling the vias 20 and interconnects 40 with a conductive material (col. 6, lines 60 to col. 7, line 7).

In re claim 3, as applied to claim 2 above, Flanner in combination with Annapragada disclose all claimed limitations including the limitation wherein the interconnects 40 are defined in the second organosilicate layer 8 and the vias 20 are defined in the first organosilicate layer 12 using a hydrogen-containing fluorocarbon gas mixture (FIG. 12 and related text, Flanner) and (col. 2, line 46 to col. 3, line 21, Annapragada).

In re claim 4, as applied to claim 2 above, Flanner in combination with Annapragada disclose all claimed limitations including the limitation wherein the conductive material filling the vias **20** and interconnects **40** is selected from the group of copper (Cu), aluminum (Al), tungsten (W), and combinations thereof (col. 8, lines 22-29, Flanner).

In re claim 5, as applied to claim 1 above, Flanner in combination with Annapragada disclose all claimed limitations including the limitation wherein the gas mixture includes one or more gases selected from the group consisting of trifluoromethane (CHF_3), difluoromethane (CH_2F_2), and fluoromethane (CH_3F) (col. 4, lines 9-23, Annapragada).

In re claim 6, as applied to claim 1 above, Flanner in combination with Annapragada disclose all claimed limitations including the limitation wherein the gas mixture further comprises a gas selected from the group consisting of carbon tetrafluoride (CF_4) and fluoroethane (C_2F_6), and combination thereof (col. 5, lines 50-64, Flanner).

In re claim 7, as applied to claim 1 above, Flanner in combination with Annapragada disclose all claimed limitations including the limitation wherein the gas mixture includes hydrogen (H_2) (col. 4, lines 9-23, Annapragada).

In re claim 8, as applied to claim 1 above, Flanner in combination with Annapragada does not explicitly disclose that the second organosilicate layer is etched at a temperature within a range of about -20°C to about 80°C .

However, there is no evidence indicating the etching temperature range is critical and it has been held that it is not inventive to discover the optimum or workable

temperature range of a result-effective variable within given prior art conditions by routine experimentation. See MPEP § 2144.05. Note that the specification contains no disclosure of either the critical nature of the claimed dimensions of any unexpected results arising there from. Where patentability is aid to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

In re claim 9, as applied to claim 1 above, Flanner in combination with Annapragada disclose all claimed limitations including the limitation wherein the second organosilicate layer is etch at a pressure within a range of about 100-2000 mtorr (col. 4, lines 30-44, Annapragada).

In re claim 10, as applied to claim 1 above, Flanner in combination with Annapragada disclose all claimed limitations including the limitation wherein the method further comprising applying an electric field to the hydrogen-containing fluorocarbon gas mixture (col. 4, lines 9-23, Annapragada).

In re claim 11, as applied to claim 10 above, Flanner in combination with Annapragada disclose all claimed limitations including the limitation wherein the electric field is a radio frequency (RF) power (col. 4, lines 9-23, Annapragada).

In re claim 12, as applied to claim 11 above, Flanner in combination with Annapragada disclose all claimed limitations including the limitation wherein the RF power is within a range of about 0 to about 300 watts/cm² (col. 4, lines 30-44, Annapragada).

In re claim 13, as applied to claim 2 above, Flanner in combination with Annapragada disclose all claimed limitations including the limitation wherein the silicon oxide layer is etched with a fluorocarbon gas mixture (col. 5, lines 51-64, Flanner).

In re claim 14, as applied to claim 13 above, Flanner in combination with Annapragada disclose all claimed limitations including the limitation wherein the fluorocarbon gas mixture further comprises a gas selected from the group consisting of carbon tetrafluoride (CF₄) and fluoroethane (C₂F₆), and combination thereof (col. 4, lines 9-23, Annapragada).

In re claim 15, as applied to claim 14 above, Flanner in combination with Annapragada disclose all claimed limitations including the limitation wherein the fluorocarbon gas mixture further includes one or more gases selected from the group consisting of hydrogen (H₂), nitrogen (N₂), oxygen (O₂), argon (Ar), and helium (He) (col. 4, lines 9-23, Annapragada).

In re claim 16, as applied to claim 13 above, Flanner in combination with Annapragada does not explicitly disclose that the silicon oxide layer is etched at a temperature within a range of about -20°C to about 80°C.

However, there is no evidence indicating the etching temperature range is critical and it has been held that it is not inventive to discover the optimum or workable temperature range of a result-effective variable within given prior art conditions by routine experimentation. See MPEP § 2144.05. Note that the specification contains no disclosure of either the critical nature of the claimed dimensions of any unexpected results arising there from. Where patentability is aid to be based upon particular chosen

dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

In re claim 17, as applied to claim 13 above, Flanner in combination with Annapragada disclose all claimed limitations including the limitation wherein the silicon oxide layer is etch at a pressure within a range of about 100-2000 mtorr (col. 4, lines 30-44, Annapragada).

In re claim 18, as applied to claim 13 above, Flanner in combination with Annapragada disclose all claimed limitations including the limitation wherein the method further comprising applying an electric field to the fluorocarbon gas mixture (col. 4, lines 9-23, Annapragada).

In re claim 19, as applied to claim 18 above, Flanner in combination with Annapragada disclose all claimed limitations including the limitation wherein the electric field is generated using radio frequency (RF) power (col. 4, lines 9-23, Annapragada).

In re claim 20, as applied to claim 19 above, Flanner in combination with Annapragada disclose all claimed limitations including the limitation wherein the RF power is within a range of about 0 to about 300 watts/cm² (col. 4, lines 30-44, Annapragada).

In re claim 21, **Flanner** discloses a method of fabricating a damascene structure, comprising: (a) forming a barrier layer 14 on a substrate 16 having a metal layer 18 thereon; (b) forming a first organosilicate layer 12 on the barrier layer 14; (c) forming a silicon oxide layer 10 on the first organosilicate layer 12; (d) forming a second



FIG. 6

(f) etching the silicon oxide layer **10** to transfer the vias **20** defined in the second organosilicate layer **8** therethrough (FIG. 6), wherein the silicon oxide **10** is etched with a gas mixture comprising a fluorocarbon gas (col. 5, lines 50-64);

Flanner discloses etching the second organosilicate layer 8 to define vias 20 therein, wherein the second organosilicate layer 8 is etched with a gas mixture comprising a Ar/N₂/CF₄, Ar/N₂/F₆, and Ar/N₂/C₉F₈/O₂ (col. 5, lines 50-64 and FIG. 6) but

does not explicitly teach that the second organosilicate layer is etched with a gas mixture comprising a hydrogen-containing fluorocarbon gases and one or more gasses selected from the group consisting of hydrogen (H_2), nitrogen (N_2), oxygen (O_2), argon (Ar), and Helium (He) as recited in the independent claim 21.

Annapragada, however, discloses a method of fabricating a damascene structure, comprising: (a) forming a barrier layer 412 on a substrate 410 having a metal layer 404 thereon; (b) forming a first organosilicate layer 416 on the barrier layer 412;

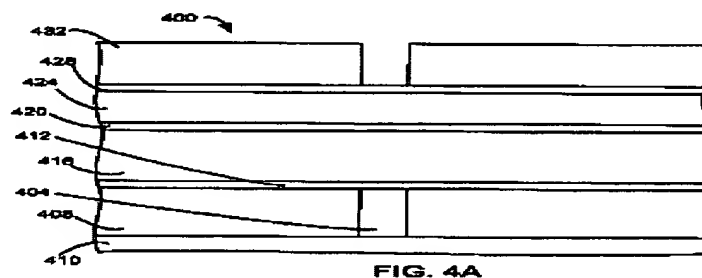


FIG. 4A

(c) forming a trench etch stop layer 420 on the first organosilicate layer 416; (d) forming a second organosilicate layer 424 on the trench etch stop layer 420 (col. 2, line 46 to col. 3, line 21 and FIGS. 4A-B); and

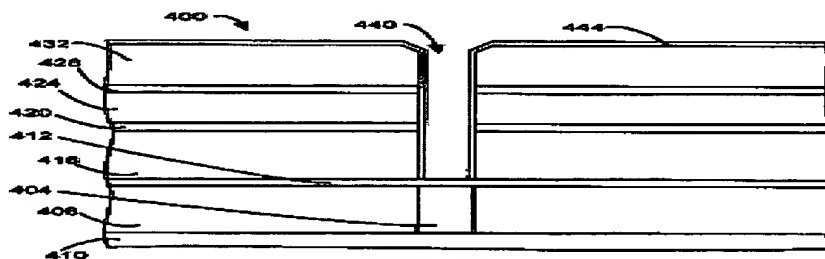


FIG. 4B

(e) etching the second organosilicate layer 424 to define vias 440 therein, wherein the second organosilicate layer 424 is etched with a gas mixture comprising a hydrogen-containing fluorocarbon and one or more gases selected from the group consisting of

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hydrogen (H₂), nitrogen (N₂), oxygen (O₂), argon (Ar), and helium (He) (col. 4, lines 9-67).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine the teaching of Flanner and Annapragada to enable the process of etching the second organosilicate layer using a gas mixture comprising a hydrogen-containing fluorocarbon and one or more gases selected from the group consisting of hydrogen (H₂), nitrogen (N₂), oxygen (O₂), argon (Ar), and helium (He) of Flanner to be performed and furthermore to provide an efficient etching process with minimal structure damage (col. 1, lines 61-62. Annapragada).

In re claim 22, as applied to claim 21 above, Flanner in combination with Annapragada disclose all claimed limitations including the limitation wherein the gas mixture for etching the second organosilicate layer comprises hydrogen (H₂) (col. 4, lines 9-23, Annapragada).

In re claim 23, as applied to claim 21 above, Flanner in combination with Annapragada disclose all claimed limitations including the limitation wherein the gas mixture for etching the second organosilicate layer comprises trifluoromethane (CHF₃), dimethylfluoride, and hydrogen (col. 4, lines 9-23, Annapragada).

In re claim 24, as applied to claim 21 above, Flanner in combination with Annapragada disclose all claimed limitations including the limitation wherein the gas mixture for etching the second organosilicate layer comprises difluoromethane, tetrafluoride, and hydrogen (col. 5, lines 50-64, Flanner) and (col. 4, lines 9-23, Annapragada).

Response to Applicants' Amendment and Arguments

4. Applicants' arguments with respect to claims 1-24 have been fully considered but are moot in view of the new ground(s) of rejection.

Conclusion

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Khiem D. Nguyen whose telephone number is (571) 272-1865. The examiner can normally be reached on Monday-Friday (8:30 AM - 5:30 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew S. Smith can be reached on (571) 272-1907. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

K.N.
August 02, 2006

Brook Kebede
BROOK KEBEDE
PRIMARY EXAMINER